

LINUX Expert

If you want to build your own home media server but you don't know where to start, help is at hand.

Tom Royal shows you how to turn a Buffalo LinkStation into a fully functioning streaming media server



UNIX AID FOR MAC USERS

PC Linux users aren't the only ones who can harness the power of UNIX. Mac computers running OS X are also equipped with a powerful UNIX operating system. To help users get started, O'Reilly has released *Learning UNIX for Mac OS X Tiger*, a book that delves into the flexible features beneath the simple interface.

The book covers areas such as using the command line, controlling Macs remotely over a network and installing applications including the X11 system and other open-source programs. Amazon (www.amazon.co.uk) is selling it for just under £10 including VAT.

HACKERS GET PAID

An intrusion prevention company is offering hackers money to report security holes. TippingPoint's Zero Day Initiative will pay for information about vulnerabilities and forward the details to the affected companies. While the companies work on a fix, TippingPoint will add protection against the flaws to its systems.

TippingPoint's systems defend desktop PCs and servers, and if enough security researchers send information to the company it hopes to gain an edge on its rivals, offering improved protection. This approach is unusual, although a few other firms pay hackers for information.

Security holes that have not been disclosed to a product's developers are known as zero day vulnerabilities. Most trading in zero day details happens on the black market, where a powerful vulnerability can command high prices from criminals.

WINDOWS VISTA COPIES LINUX

Microsoft will adopt a more Linux-like security setup when it releases its new version of Windows, formerly known as Longhorn (see *Newsfile* for the latest on the name change). While Linux limits a system's users to certain types of task, Windows XP offers more limited options and many people choose to operate their PCs as administrators. This leaves their systems open to spyware and other problems. Windows Vista will offer limited versions of the administrator account, mirroring the model used by Linux and other variations of UNIX.

We first reviewed Buffalo's LinkStation in *What's New, Shopper* September 2004. It's a small network attached storage (NAS) device that's designed to be easy enough for home users to set up on their networks in minutes. It is essentially a large hard disk with a network interface. You plug it into your network and Windows PCs can use their built-in file-sharing software to view the disk and copy files to and from it. This sounds straightforward, but you can do a lot more with a LinkStation if you know a bit about Linux.

In *Shopper* May 2005 we published a feature that explained how to build a simple home media server using a Mini-ITX motherboard, a small case and a copy of Red Hat Linux. This simple computer had a slow processor and not much memory, but it was perfectly capable of streaming a huge library of MP3 files to computers around your home. The Buffalo LinkStation is very similar to that server. Like our music server, it contains a tiny processor (a PowerPC chip) that's capable of streaming music files. More importantly, it has something else in common with our MP3 server: it runs Linux.

This isn't unusual. As consumer electronics become increasingly complex, manufacturers have started to build their devices using small, customisable computers rather than dedicated, bespoke hardware. As they use a popular operating system, it's relatively easy for them and their customers to upgrade the gadgets, adding new features or fixing errors. Many wireless access points run Linux, including the Linksys WRT54G. There are dozens of websites describing how owners can improve transmission rates and add new features by running embedded Linux operating systems on these devices.



LINKSTATION MEDIA SERVER

In Japan and the US, Buffalo sells a small, customisable Linux server called the Kuro Box. Roughly translated, Kuro means expert. Inside the case the Kuro Box is very similar to a LinkStation.

```
Telnet 192.168.1.225
~
~
~
~
~
~
~
~
~
~
tom@LINKSTATION:/mnt/share$ more /mnt/share/passwdbackup
root:*jNSbCQUj1eiM:0:0:root:/root:/bin/bash
bin:*:1:1:bin:/bin:
daemon:*:2:2:daemon:/usr/sbin:
sys:*:3:3:sys:/dev:
adm:*:4:4:adm:/var/adm:
sync:*:6:8:sync:/bin:/bin/sync
shutdown:*:7:9:shutdown:/sbin:/sbin/shutdown
halt:*:8:10:halt:/sbin:/sbin/halt
operator:*:12:0:operator:/root:
ftp:*:15:14:ftp:/usr/sbin:/bin/false
nobody:*:99:99:nobody:/home:/bin/sh
tom:/jNSbCQUj1eiM:100:1000:/:/home:/bin/bash
tom@LINKSTATION:/mnt/share$
```

By editing the LinkStation's password file you can gain root access to its operating system



The main difference between the two is that the LinkStation is set up to restrict user access to its operating system. Fortunately, it's fairly easy to get root access to a LinkStation and this allows you to put yours to myriad uses other than its original role as a file server. We'll show you how to turn a LinkStation into a Universal Plug and Play (UPnP)-compatible media server ready to stream music, video and pictures around your home.

The UPnP standard allows home automation and media devices to communicate over TCP/IP networks without requiring any configuration. Many of the network media receivers on the market come with their own proprietary server applications, a lot of which run only on Windows. Some will connect to any UPnP server, though, no matter what operating system it runs. Netgear's MP101 wireless music player supports UPnP, as do some Sony and Philips products.

Combined with one of these players, a LinkStation modified to run UPnP server software can form the basis of a versatile home jukebox. The LinkStation has more than enough room for hundreds of albums recorded in MP3 format, and you could access them instantly through your hi-fi or home cinema system. Devices such as the MP101 enable you to browse through your music by artist, album, genre or file, which is much easier than flipping through piles of LPs or CDs. It will also stream multimedia data to any computers on the network through receiver applications such as Nero ShowTime 2 for Windows.

WHAT YOU'LL NEED

Not all LinkStations can be converted in the manner described here. In 2005 Buffalo started shipping a newer version that uses a MIPS processor and different firmware. Buffalo advised us that all LinkStations with a Gigabit Ethernet port, and some 250GB LinkStations with a 10/100 network connection, use this new hardware. While it is possible to modify MIPS LinkStations – and there are some very fine instructions for doing so at www.geishuettner.de/docs/linkstation – this month's *Linux Expert* project works only with older PowerPC models.

As we went to press we received an email from TwonkyVision, which develops the software we've used to turn the LinkStation into a UPnP media server. MIPS LinkStations are now supported, which is great news for owners of these newer devices.

In order to follow the method below you'll need an original version 1 PowerPC-based LinkStation of any capacity, although the 120GB and 160GB versions lend themselves best to storing large media collections. You'll also need to obtain a copy of Buffalo's v1.44 firmware, which is distributed in a file called `fw_up144_14.zip`. This file is no longer available from Buffalo's website but can be found on other sites. You'll also need some Linux UPnP server software. We'll explain how to install the TwonkyVision MediaServer, which costs €15 (around £10) from www.twonkyvision.de. This server has several advantages over other alternatives. It's small, it takes up very few system resources and it comes in a precompiled binary file designed for the LinkStation.

Finally, remember that modifying your LinkStation in any way could invalidate its warranty. The procedure detailed in this article isn't particularly difficult to follow, but a mistake could leave you locked out of your LinkStation for good.

```

c:\ Telnet 192.168.1.225

BUFFALO INC. Link Station series HD-HLAN <HIDETADA>

LINKSTATION login: root
Password:
Linux <none> 2.4.17_mv121-sandpoint #990 2004||> 5π€ 21 1^n ||Γ=ΓF^n 13:39:00 JST ppc
unknown
root@LINKSTATION:~#
  
```

Once you have root access through Telnet, you can install new software applications

Buffalo advised us that a broken LinkStation would still be covered by its warranty if it was running its original firmware. So be warned.

GAINING ROOT ACCESS

The first step towards building the LinkStation media server is to gain access to the root account on the LinkStation's Linux operating system. We don't know the password that was originally given to this important account, and it's not worth trying to crack it, so instead we'll just replace it with one of our choice.

To begin, install version 1.44 of the LinkStation's firmware. You'll need to use a Windows computer that's connected to the same network as the LinkStation. Extract the firmware you downloaded from the darker corners of the internet (run a Google search for `fw_up144_14.zip`), and run the file called `HD-HLAN FWUpdate.exe`. This will replace the Linux operating system on your LinkStation with one that we can get into.

Once the update has finished, log into the LinkStation through its web interface and add a

new user account. Give this account a name and the password you want to use when logging in as root. Once this is done, close the web interface.

Version 1.44 of the LinkStation firmware allows you to access the LinkStation through Telnet. The unit will try to get an address automatically using DHCP, but you can also set its IP address with the included Windows utility. We recommend you do this so that you know which IP address to connect to.

Open a Telnet connection to the LinkStation across your network and log in with the username and password you just created. Make a new directory in the web server root directory by typing:

```
mkdir /www/cgi-bin34
```

Because of a configuration error in version 1.44 of the firmware, any scripts placed inside this directory can be executed with full system privileges by a user accessing the LinkStation's built-in web server. We'll write a script that enables our account to edit the password file and then

BARE-BONES LINUX

Every Linux user should master a handful of essential commands

These days Linux is very easy to use. Some versions have graphical user interfaces that are as good as, if not better than, Windows and most modern distributions are stuffed with handy utilities, programs and even fairly advanced games. Just as Windows users rarely, if ever, have to dip into the command line, today's Linux user may never do anything more complicated than clicking on a few icons with a mouse.

But sometimes it pays to learn how to use the older, less straightforward programs that sit virtually redundant on your system. This kind of knowledge comes in very handy when you want to play with the cut-down distributions you'll find in devices such as the Buffalo LinkStation.

Some of the basics include knowing how to change directory using the `cd` command, how to view running processes using `ps` and how to delete and copy files using `del` and `cp`. These are all essential commands that anyone who's serious about using Linux should know. Sometimes classic commands are updated with newer, easier programs. The `vi` text editor is tricky for beginners, who may prefer the easier `pico` editor.

The disadvantage in relying on newer programs is that you can't be sure they will always be available. The text editor `vi` may seem scary to begin with because of its unhelpful interface, but you can virtually guarantee that a copy of it will be included with every version of UNIX you'll ever use. It's great for getting out of a corner when an incorrect configuration file prevents the system working properly, so practise with it before you find you have to rely on it.

Similarly, we've mentioned the 'more' command in this article. If you want to see the contents of a file, more will do the job, although it's limited compared to a newer command called 'less'. Using less enables you to scroll back and forward through a file, and the command does not have to read the entire file before it displays its contents.

Using more can be slow, and you'll need to quit and re-run the program if you scroll past the point in the file that you are trying to find. However, while most systems provide the less command, not all do and the LinkStation recognises only more.



execute it using a web browser. Create a new script with the command:

```
vi /www/cgi-bin3/access.sh
```

Enter text insert mode by pressing I on your keyboard, then type in the following two lines. When run, this script will change the file permissions for the LinkStation's password file, allowing you to edit it:

```
#!/bin/sh
chmod 666 /etc/passwd
```

Save this file and close it by pressing Control-C to enter command mode and type:

```
:wq
```

It's always worth checking that you've written your scripts correctly, especially if you're unfamiliar with editing files using vi. Use the 'more' command to display the file's contents onscreen and verify that both lines are correct:

```
more /www/cgi-bin3/access.sh
```

If it looks correct, close your Telnet session by typing 'exit'. Open a web browser on your computer and tell it to open the file you have just created. In our example, where the LinkStation's IP address is set to 192.168.1.225, the script has the following address:

```
http://192.168.1.225/cgi-bin3/
access.sh
```

By opening this page in your web browser you will automatically execute the script, so your user account will be able to edit the LinkStation's password file. Log back into the LinkStation with Telnet, and use the following command to copy the password file to a shared directory that's visible from a networked computer:

```
cp /etc/passwd /mnt/share/
passwdbackup
```

There are two reasons for doing this. The first is that we can work on a copy of the file in the knowledge that if something should go wrong we won't lock ourselves out of the LinkStation. Second, because the file is shared on the network we can edit the file using a text editor on another computer if necessary. The quickest way to edit the file, though, is to use vi. Open the copy of the password file in vi by typing:

```
vi /mnt/share/passwdbackup
```

This file contains a list of all the user accounts available on the LinkStation, together with their passwords. The bottom line is the username you created earlier. On our system it looks like this:

```
tom:/jNSbCQVj1eiM:100:1000:./home:
/bin/bash
```

The passwords in this file are encrypted for security. Our password, which in this case is 'password', has been encrypted into the letters that appear between 'tom:' and the second colon. In

this example it is 'jNSbCQVj1eiM'. The top line of the file contains the encrypted password that's currently assigned to the root account. If you're connecting over Telnet from a Windows PC this top line may even be obscured due to the badly written client that comes with Windows. Use the right arrow key to move across this top line until it's revealed. It should look something like this:

```
root:/aHjTVKCaSCwM:0:0:root:/root:
/bin/bash
```

By copying the encrypted password from the line that describes our user account to the same place on the line describing the root account, we can replace the root account's password with the one we chose earlier. Move your cursor to the first character of the root account's encrypted password, just after the 'root:' and press the X key to delete the password one character at a time.

Once you have deleted the whole password and the cursor is hovering over the second colon, press the I key. Carefully type in the encrypted password as it appears in your user account, character by character. Remember that the password is case sensitive. In our example, we ended up with the following line:

```
root:/jNSbCQVj1eiM:0:0:root:/root:
/bin/bash
```

Now enter command mode by holding down Ctrl-C, type :wq to save the file and exit. Before you go any further, list the file onscreen by using the more command:

```
more /mnt/share/passwdbackup
```

The results should look like this, with the same encrypted password in both the line for your user account and the root account:

```
root:/jNSbCQVj1eiM:0:0:root:/root:
/bin/bash
bin:*:1:1:bin:/bin:
daemon:*:2:2:daemon:/usr/sbin:
sys:*:3:3:sys:/dev:
adm:*:4:4:adm:/var/adm:
sync:*:6:8:sync:/bin:/bin/sync
shutdown:*:7:9:shutdown:/sbin:/sbin/
shutdown
halt:*:8:10:halt:/sbin:/sbin/halt
operator:*:12:0:operator:/root:
ftp:*:15:14:ftp:/usr/sbin:/bin/false
nobody:*:99:99:nobody:/home:/bin/sh
tom:/jNSbCQVj1eiM:100:1000:./home:
/bin/bash
```

When you're absolutely sure you've copied the password correctly, you can copy the edited password file over the one used by the LinkStation. Enter the following copy command:

```
cp /mnt/share/passwdbackup /etc/
passwd
```

Once this is done we can test our new root password. If something has gone wrong you may not be able to log in at all, so leave your existing Telnet window open as a back door just in case. Open a second Telnet connection to the LinkStation and, at the login prompt, enter the username root

and the password you chose earlier. You should now be logged in with full administrative privileges. If the password doesn't work, go back to your old Telnet connection and check the password file, making absolutely sure you have copied the encrypted password correctly.

INSTALLING THE MEDIA SERVER

Now that you have access to the LinkStation through its root user account you can customise it to your needs. To enable it to stream video and music we need to install TwonkyVision's UPnP MediaServer. You'll need a copy of the server binaries, which cost €15 (around £10) from www.twonkyvision.de.

If you want to make sure everything works before you spend any money, download the free MusicServer package. This contains a trial version of the LinkStation media server that's limited to run for only 10 minutes at a time. If you decide to do this, rename the executable file from mediaserver-trial to mediaserver so that you can replace it easily with the full version later.

When you have your copy of the MediaServer executable, copy it to the LinkStation's shared directory from your computer. You can log in using Telnet and copy it from this location (in /mnt/share) to another folder if you wish, but for the sake of simplicity we'll run it from this folder.

Create a folder for your media files inside this shared directory. We set up our test LinkStation to serve 80GB of MP3 files, so we created a directory called 'music' and copied a few MP3 files into it for testing purposes.

Once the executable file is installed we can use the LinkStation as a media server, but at the moment we have to start the server program manually. To start it up you need to log in using Telnet and run the server from the command line. Fortunately, it's fairly easy to set up the LinkStation to start and stop the media server software automatically when you turn it on and off. The easiest way to do this is to install a ready-made script that you can download from the web.

INSTALLING THE STARTUP SCRIPT

You can download a script that starts and stops the TwonkyVision MediaServer from the files section of LinkStation General at http://groups.yahoo.com/group/linkstation_general, a Yahoo! group dedicated to modifying the LinkStation software. It's called twonky and was uploaded by a user called sanfrenchysco. Download this file and copy it to your LinkStation's shared folder, then Telnet into the device and open the script in vi by typing:

```
vi /mnt/share/twonky
```

About 12 lines down, you should see a line that reads "Check that binary file exist". You need to edit the line after this to include the address of the media server executable. Press the X key to delete the existing path, then press the I key to enter insert mode and replace it with the correct path. If you left the media server in the share directory, the correct path will be:

```
/mnt/share/mediaserver
```

Now scroll down until you see the line:



PLAYING MEDIA USING UPnP

The TwonkyVision software we installed on the LinkStation functions as a UPnP media server. In order to use this kind of server you'll need a UPnP client, or player, to access your media files.

UPnP media streaming allows a single server to send multimedia files to one or several players on a home network. As it relies on a standard protocol, UPnP enables players made by different manufacturers to use the same server. The UPnP framework allows your server to send several different types of media file, including music, photographs and video files.

Two types of UPnP player are commonly available: music players that can stream and play only audio files, and multimedia players that can cope with video too. Each player connects with the server and tells it what kinds of files it can play. The server then sends a file list to the player so that the user can choose the music or video they want.

MUSIC PLAYERS

UPnP music players are great if you want instant access to every track in a large MP3 collection. They connect to your hi-fi amplifier and use either a wired or wireless network to connect to

▼Netgear's MP101 UPnP music player won a Shopper Best Buy award



the server. Most have a small LCD screen and a remote control, making it easy to select from the library of music on your server.

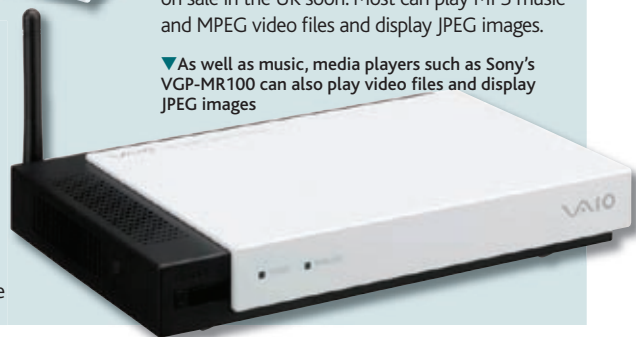
A good example is Netgear's MP101. This player costs around £85 and connects to both wired and wireless networks. It won a Best Buy award in *What's New, Shopper* July 2004, as well as a special award in our 200th issue. Another good product is Roku's SoundBridge, which costs more

but comes in a remarkably good-looking cylindrical container and won't look out of place with even the smartest hi-fi system.

MEDIA PLAYERS

UPnP media players connect to a television and enable you to stream music, videos and pictures from your server. They don't usually have a screen of their own as you can select which files to play using your TV and a remote control. A good example is the Philips Streamium SL300i, which costs less than £150, or the Pinnacle ShowCenter 200. Sony also manufactures a media player, the VGP-MR100, which should be on sale in the UK soon. Most can play MP3 music and MPEG video files and display JPEG images.

▼As well as music, media players such as Sony's VGP-MR100 can also play video files and display JPEG images



```
echo "Starting the Twonky Mediaserver"
```

The line beneath it sets the directory in which the media server is located using a change directory (cd) command. Alter this line so that it points to the directory in which you stored the media server. If you left it in the shared directory, you should change this line to:

```
cd /mnt/share/
```

Enter your new path, then save and exit by pressing Ctrl-C and typing :wq. Finally, make sure the changes you have made are correct by reading through the file using more:

```
more twonky
```

If everything looks OK, copy this file to /etc/init.d with the command:

```
cp /mnt/share/twonky /etc/init.d/twonky
```

The next step is to test this script. Use it to start the media server by typing this command:

```
./twonky start
```

This should start the server. To find out if it has worked, list the processes that are currently running on the LinkStation by typing:

```
ps -e | grep "media"
```

This lists all the running processes that have names containing the string 'media'. It should show several processes called 'mediaserver', which are created by the MediaServer application. If nothing is listed, check that the paths in the twonky script are

correct and try again. Once you've verified that the server is running, try to shut it down by typing:

```
./twonky stop
```

The shutdown process takes around 20 seconds. Once it has finished, list the processes again using the same ps command. This time nothing should show up. If this is the case, all that remains is to enter some links that will trigger this script when the LinkStation is switched on and off. Use the following commands to add the necessary links:

```
cd /etc/rc.d/rc2.d
ln -s /etc/init.d/twonky S99twonky
cd /etc/rc.d/rc6.d
ln -s /etc/init.d/twonky K92twonky
cd /etc/rc.d/rc0.d
ln -s /etc/init.d/twonky K92twonky
```

The media server should now start and stop with the LinkStation itself. Use the reboot command to restart the server and then check that the media server processes are running. If they are, all that remains is to edit the media server's configuration file. Open it using the following command:

```
vi /mnt/share/twonkyvision-mediasever.ini
```

This text file contains lots of options for customising the media server. For the moment, the only change you need to make is to edit the line near the top of the file that begins with contentdir=. This tells the server where to search for your media files. In our test we copied a few MP3 files into /mnt/share/music, so we changed this line to:

```
contentdir=/mnt/share/music
```

Once you've saved this file and exited vi, the LinkStation is ready to serve your media files using UPnP. Reboot it and wait a few minutes for the server to index your media files, then turn on your UPnP client (see box above) and wait for it to detect the LinkStation on your network.

FURTHER PROJECTS

It's only a matter of time before home media servers become popular and digital files replace bulky CDs, DVDs and video tapes. Having read this article you can beat the rush, and you won't have to spend a great deal of money. A 120GB LinkStation can cost less than £150 and the software you need to convert it from a boring file server to a cool music broadcasting gadget costs around £10.

This kind of media server is just one application of a modified LinkStation. From the basic setup we've described here you can customise it to stream music, video and pictures to several devices around your home. If you want to try something more advanced, you could add more features to the LinkStation to turn it into a fully fledged home server.

Other users have successfully installed compilers, DHCP servers, mail servers and even alternative versions of Linux. Yasunari Yamashita's website (www.yamasita.jp/linkstation.en) documents his large collection of LinkStations, some of which run as internet servers. **CS**

NEXT MONTH

SUPERCARGE YOUR WEBSITE

We show you how to power your website using the MySQL database